NUMERICAL SIMULATION OF DIFFUSION FLAMES CLOSE TO LOCAL THERMODYNAMIC EQUILIBRIUM

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The goal of this project is to use the local thermodynamic equilibrium formalism, initially developed for plasma numerical simulations, in order to study a hydrogen laminar diffusion flame. The chosen geometry is the co-flow injector, in which a hydrogen-nitrogen mixture and air are injected separately from concentric pipes.

These numerical simulations were performed using Coolfluid (Computational Object Oriented Library for Fluid Dynamics), which is under development at the von Karman Institute.

The first thing made in this project was to develop a library for computation of the thermodynamics and transport properties of a mixture of perfect gases. This library is based on Pegase 4.5 and Mutation, and is written in ANSI-C. This library and the coupling with Coolfluid have been successfully tested on blunt bodies and reentry applications.

The model of the Navier-Stokes equations implemented in Coolfluid have then been extended to be able to use an incompressible model, in Local Thermodynamic Equilibrium, holding account for (de)mixing.

Finally, this implementation has been used to study, firstly a cold flow injector (with no chemical reaction), and secondly the diffusion flame. Unfortunately, no satisfying results have been obtained for the combustion problem.

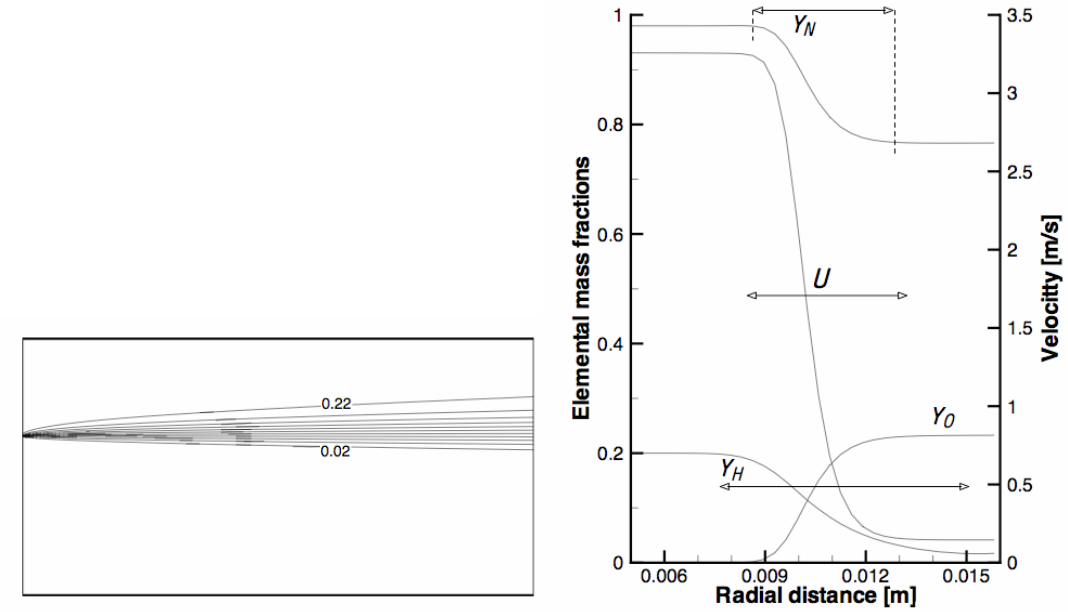

Figure 1: Mixing Layer of the coflow injector (left) and radial profiles of velocity and elemental fractions (right)